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ABSTRACT

The purpose of this study was to determine if there were specific teacher behaviors related to the differences in mathematical achievement of four- and five-year-old lower socioeconomic status children across two mathematical curricular intervention treatment conditions. Results indicated that more indirect teacher behavior and the active involvement of the student in the learning process are significantly more effective in facilitating student achievement than is a direct instructional mode. A second interesting finding is that a significant negative correlation was shown to exist between the teacher judgment of the correctness of a response and student achievement. (Author/MN)

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TEACHER BEHAVIORS RELATED TO THE MATHEMATICAL ACHIEVEMENT OF YOUNG CHILDREN

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Abstract

TEACHER BEHAVIORS RELATED TO THE MATHEMATICAL ACHIEVEMENT OF YOUNG CHILDREN

The purpose of this study was to determine if there were specific teacher behaviors which were related to the differences in mathematical achievement of 4- and 5-year old lower socio-economic status children across two mathematical curricular intervention treatment conditions. Results indicated that more indirect teacher behavior and the active involvement of the student in the learning process are significantly more effective in facilitating student achievement than is a direct instructional mode. A second interesting finding is that a significant negative correlation was shown to exist between the teacher judgement of the correctness of a response and student achievement.

In recent years there has been increasing attention directed toward the use of observational systems to study teaching. One of the main purposes for which they have been used is to monitor the nature of the instructional activities used in the implementation of educational programs. A second important purpose has been to explore the relationship between teacher behaviors and student achievement. Interestingly, however, there has been relatively little research which has combined these two purposes. (Rosenshine and Furst, 1973). In addition there has also been very little research of either type with young (preschool age) children (Gordon and Jester, 1973). As the number and variety of educational programs available for young children continue to grow there is an increasing emphasis on the need to both monitor the nature of instruction during implementation so that the results of curricular comparisions can be considered as valid and to determine the types of instructional behaviors which are most effective in facilitating achievement in young children.

The present investigation grew out of a larger study comparing the effects of two mathematical curricular approaches (perceptual transformation experiences vs. numerical operational experiences) on the achievement of an understanding of numerical correspondence and the recognition and maintenance of equivalence by 4- and 5-year old lower socioeconomic status children (Becher, 1978).

As part of this larger study, post hoc interaction analysis of a stratified random sample of tape recorded instructional sessions in each treatment condition was performed in order to control for the effect of instruction. Results of the analysis indicated that a high mean percent of behaviors characteristic of the intended instructional strategy had been emitted in each condition (I-$\bar{x}$=67.1%; II-$\bar{x}$=65.4%). Results of a t test indicated no significant difference ($p>.05$) between the two conditions on this factor. This indicated that the overall nature of instruction was a constant across treatment conditions and thus not

a contributing factor to the significant differential effectiveness of curricular approaches which had been shown to exist. However, since there were significant differences ($p \leq .05$) in achievement gains between groups of students within each treatment condition, and since no significant differences ($p > .05$) were shown to exist in the initial mean performance scores for the same groups, the present study was conducted to determine if the differences in achievement gains in both conditions were related to specific teaching behaviors and strategies.

Subjects. Ninety-six 4- and 5-year old lower socio-economic status children (48 males and 48 females) served as subjects. They were drawn from Head Start programs, Title I prekindergarten classes and social welfare supported preschool and day care centers in a large midwestern city.

Teachers. Eight senior white female early childhood education majors at a large midwestern university served as the teachers. These instructors were initially chosen on the basis of recommendations regarding their previous work with children. They were then re-evaluated following their participation in seven training sessions.

Design and Procedures. Subjects were individually pre- and post-tested using a modified version of the standard Piagetian conservation of number test (Piaget 1952, Becher 1974), in order to assess their ability to establish numerical correspondence and to recognize and maintain equivalence during perceptual transformations. Based on their pretest performance subjects were classified into three levels of mathematical achievement and within these levels according to sex. The 96 subjects were then randomly assigned within blocks to one of the two treatment conditions. Within each condition the 48 subjects were then randomly assigned to an instructional group ($n=4$). This procedure resulted in twelve instructional groups per treatment condition.

Each of the instructional groups received twelve 10-15 minute instruc-

tional sessions occurring at the rate of three instructional sessions per group per week. The lessons as well as the general instructional procedures were standarized within each treatment condition. Both conditions used an interactive instructional strategy which is defined as a mode of instruction in which there is reciprocal communication. It is characterized by the use of a questioning procedure to stimulate and explore the thoughts and ideas of students and involves the key behaviors of 1) solicitation of information, 2) requests for clarification, and 3) response to solicitations or requests (Hough and Duncan 1970). Also, both conditions involved children as participants and manipulators of objects.

Four trained instructors, blind to the experimental hypotheses, were randomly assigned to each of the treatment conditions. Within each condition each instructor administered identical treatments to each of the three instructional groups which had been randomly assigned to him. Thus, throughout the study, each instructor taught a total of 36 instructional sessions. All sessions were tape recorded so that post hoc instructional analysis could be performed.

From the 36 lessons taught by each instructor, four were chosen for analysis using the Observation System of Instructional Analysis (OSIA) (Hough and Duncan 1970, 1972). The lessons were chosen through a stratified random selection process in which one lesson was selected from each of the four lesson groupings (Lessons 1-3, 4-6, 7-9, 10-12).

Following OSIA analysis, Pearson product moment coefficients of correlation between mean student gain scores for each of the eight instructors and the teacher behavior categories, strategies, and ratios of OSIA were computed in order to determine if the differences in achievement gains in both conditions were related to specific teaching behaviors and strategies.

Results and Discussion. Pearson product moment coefficients of correlation calculations revealed a number of significant correlations ($p < .05$; 6df)

between specific teacher behavior categories, strategies, and ratios and student achievement gains in both conditions. Behavior categories, strategies, and ratios which were found to be positively correlated with achievement gains were: 1) teacher requests for students to clarify substantive statements (r=.89); 2) student substantive response to teacher solicitations of substantive information (r=.80); 3) teacher initiated substantive interactive strategy (which involves the teacher behaviors of requests for substantive information and clarification and the student behavior of substantive response) (r=.70); 4) teacher I/D (indirect behaviors/direct behaviors) (r=.72); 5) teacher I/D in response behavior (r=.70); 6) questions/lectures (r=.70); 7) reflective questioning/drill questioning (r=.77); 8) student behaviors/teacher behaviors (r=.70); 9) student I/D (r=.84); and 10) student I/D in response behaviors (r=.92). Behaviors which were found to be negatively correlated with achievement gains were: 1) teacher direct initiation of substantive information (r=-.70); and 2) teacher judgment of the correctness of a student's response (r=-.70).

The results of this study indicate two important and interesting educational findings. The first is that more indirect teacher behavior, and thus more active involvement of the student in the learning process, is significantly more effective in facilitating student achievement gains than is a direct instructional teaching mode. While this view is generally accepted, it has been basically unsupported. In almost all of the previous investigations nonsignificant, although positive, results have been found (Rosenshine, 1971; Rosenshine and Furst, 1973). In order to attempt to explain the findings of this study, a number of previous studies were critically examined. In the studies where nonsignificant but positive results were reported, subjects were upper elementary, junior and senior high school students. However, in the studies with young children (Allen, 1969; Conners and Eisenberg, 1966; Harris and Serwer, 1966;

and Wallen, 1966) significant positive correlations were reported. Thus it appears that while the use of indirect teaching behaviors do tend to result in achievement at all levels, they seem to have a significant effect with young children. This finding together with the results of the present investigation suggest a relationship between the impact of an indirect teaching strategy and the level of development of the subjects involved. A possible reason for this relationship may be that children at different levels of development differ significantly in the ways in which they learn which in turn influences the type of instruction which is appropriate. Since young children are unable to attend to direct instruction for any length of time, their involvement (both physical and verbal) in the learning task is critical. Older children, on the other hand, are more able to learn from a variety of instructional strategies. Therefore, while an indirect mode of instruction may be both perferred and effective at all levels of development the extent of effectiveness with older children is less than if it were the only effective instructional mode available.

The second interesting finding is the significant negative relationship between the teacher's provision of feedback by his indication of the judgment of the correctness of a response and student achievement gain. A possible explanation for this finding is that teachers who are concerned with "correctness" or uncorrectness" are more interested in "conveying content" than in "teaching" children. Further post hoc analysis revealed that in fact those teachers who tended to judge the correctness of responses asked significantly more drill questions than reflective questions ($r=.81$) and solicited clarification of student ideas significantly less often ($r=-.67$) than the teachers who did not judge correctness as much. This finding is consistent with Piaget's theory of learning (Ginsburg and Opper, 1969) in which he suggests that it is the student's reflection on his own involvement in the learning process and his receipt of "corrective

feedback" from his manipulation of materials rather than from adult judgment which is the basis for the acquisition of knowledge. It is especially interesting that the relationship was shown to exist in instruction involving math since math is often viewed as a convergent subject in which "rightness" and "wrongness" is critical.

The findings of this study together with those of previous investigations have important implications for educating young children. While further research is still necessary it is evident that if young children are to be effectively educated the nature of the instructional behaviors and strategies used is critical.

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